11th Metrology for digital transformation day

New metrological resources for Industry 4.0

Marcos Bierzychudek

M4DT day | September | 2022

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Instituto Nacional de Tecnología Industrial

Ministerio de Economía Argentina
Secretaría de Industria y Desarrollo Productivo

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Project overview

Key points

Associative research project funded by the Ministry of Science and Technology of Argentina.

Partners:

HITEC SRL sensing & control

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18 RRHH

$335k

18 months

2023 end

Project overview

Objetives

- To ensure the calibration data quality in its generation, use and transference by means of a digital calibration certificate.

- To reduce the effort to obtain traceability, bringing the standard closer to the instrument under calibration.

Project overview

Traceability chains

- To implement a digital traceability chain from the vibration standard at INTI up to the sensors produced by HITEC. The work involves a new standard for INTI and the implementation of calibration procedures at HITEC.

- To implement a digital traceability chain in an automated process of calibration of multifunction calibrators. The work involves the development of the calibration procedure, software and of a multivariable multiplexer.

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Developments and results

Digital SI

Digital Calibration Certificate

- A Digital Calibration Certificate is a document that is transferable, accessible, secure, robust, interoperable, reusable, machine-readable, capable of being understood by humans as well as machines, and capable of storing metadata like any other information.

- The format chosen is the XML format and the certificate may be digitally signed.

Digital SI

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Certificado de Calibración

Elemento	**Objeto:** Acelerometro **Fabricante/Marca:** — **Modelo/Número de serie:** —/— **Id. del usuario:** —
Determinaciones requeridas	Calibración según PEMAXXXX
Fecha de recepción	01/03/2022
Fecha de calibración	Desde 07/03/2022 hasta 18/03/2022
Solicitante	— Calle — N°— —, —
Lugar de realización	INTI-GOMYC-SOMCEI-Depto. Mecanica y Acustica Avenida General Paz 5445, Edificio 3 y 44 [CP 1650] San Martín, Provincia de Buenos Aires, República Argentina Teléfono: (54 11) 4752 5402 / (54 11) 4724 6200 (interno 7444) E-mail: fisicaymetrologia@inti.gob.ar

Buenos Aires, 25 de Marzo de 2022.

Digital SI

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Digital SI

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Sistema Internacional de Unidades Digital

Proof of concept

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DCC

<m4dt@inti.gob.ar>

Vibration traceability chain

INTI primary system

DCC

HITEC Standard

DCC

Calibrator 9100 or SV110

DCC

Vibration sensor

Vibration traceability chain

INTI primary system

DCC

HITEC Standard

DCC

Calibrator 9100 or SV110

DCC

Vibration sensor

INTI calibrates the HITEC standard by interferometer method under norm ISO 16063-11 (method 1 and 2).

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<gzapata@inti.gob.ar>

Vibration traceability chain

INTI primary system

DCC

HITEC Standard

DCC

Calibrator 9100 or SV110

DCC

Vibration sensor

INTI implemented the digital calibration certificate for accelerometer and calibrators

Vibration traceability chain

INTI primary system

DCC

HITEC Standard

DCC

Calibrator 9100 or SV110

DCC

Vibration sensor

HITEC calibrates the calibrator 9100 by a back to back method.

Vibration traceability chain

INTI primary system

DCC

HITEC Standard

DCC

Calibrator 9100 or SV110

The calibrator is used with a 6.5 digit multimeter.

DCC

Vibration sensor

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Vibration traceability chain

INTI primary system

DCC

HITEC Standard

DCC

Calibrator 9100 or SV110

DCC

Vibration sensor

HITEC wrote the calibration procedures and made the software.

Vibration traceability chain

INTI primary system

DCC

HITEC Standard

DCC

Calibrator 9100 or SV110

DCC

Vibration sensor

XML

Vibration traceability chain

INTI primary system

DCC

HITEC Standard

DCC

Calibrator 9100 or SV110

DCC

Vibration sensor

In-situ or remote calibration

Vibration traceability chain

INTI primary system

DCC

HITEC Standard

DCC

Calibrator 9100 or SV110

HITEC modified the sensor system to read and use the DCC.

DCC

Vibration sensor

Electrical traceability chain

Fully automated system to calibrate multifunction calibrators.

Magnitude	Range
DC voltage	100 mV – 1000 V
AC voltage	100 mV – 1000 V up to 10 kHz
DC current	10 µA – 20 A
AC current	10 µA – 20 A up to 5 kHz
Resistance	1 Ω – 1 GΩ
Capacitance	1 nF – 100 µF
Frequency	10 MHz

Electrical traceability chain

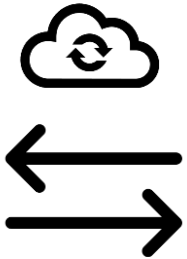
Electrical traceability chain

Electrical traceability chain

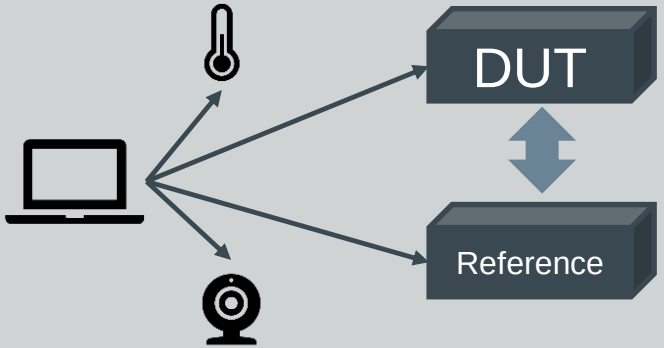
Transportable calibration system

Electrical traceability chain

Metrologist



Customer laboratory

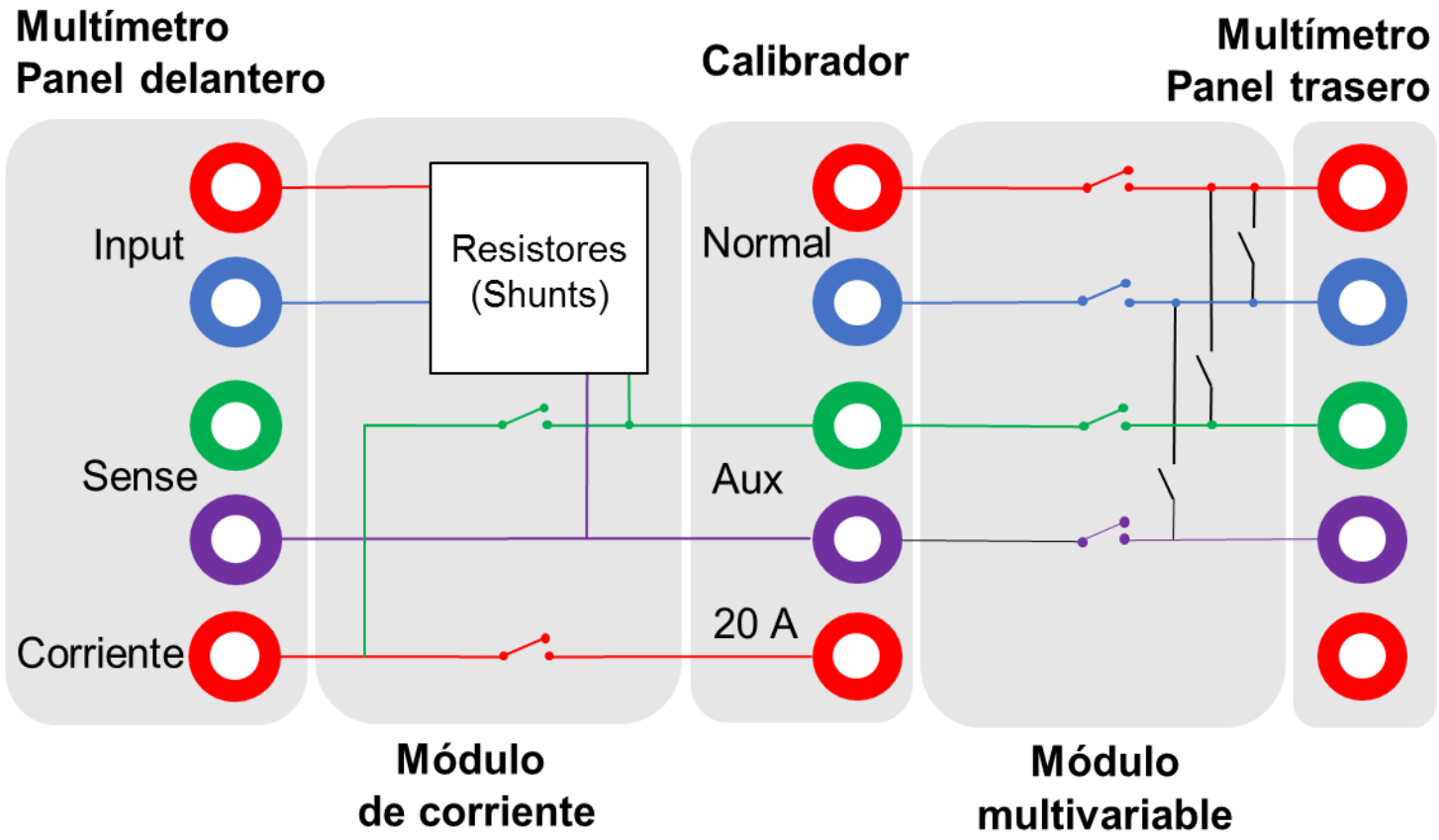


Electrical traceability chain

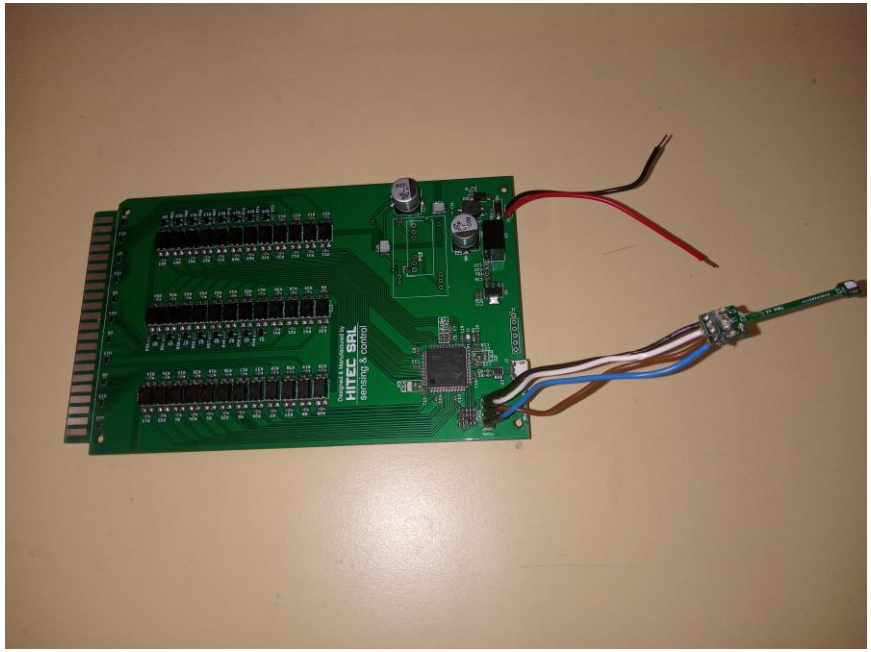
Multivariable multiplexer specifications:

- Isolation resistance > 1 TΩ (0.1% in 1 GΩ)
- Thermoelectric voltage < 0.1 µV (1 ppm at 100 mV DC)
- Contact resistance < 1 Ω (10 ppm at 20 kHz)
- Stray capacitance < 5 pF
- Maximum voltage 1000 Vrms
- Maximum current 20 Arms.

Electrical traceability chain

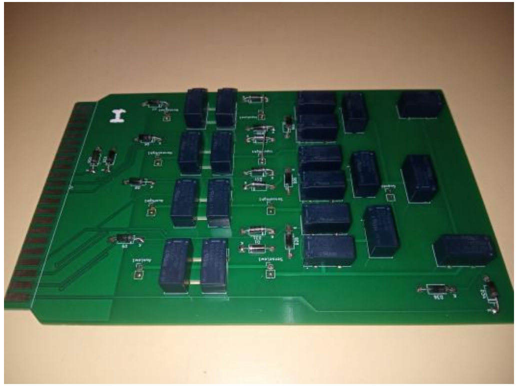


Electrical traceability chain



Electrical traceability chain

Preliminary uncertainty evaluation using a Fluke 5700 and HP3458.



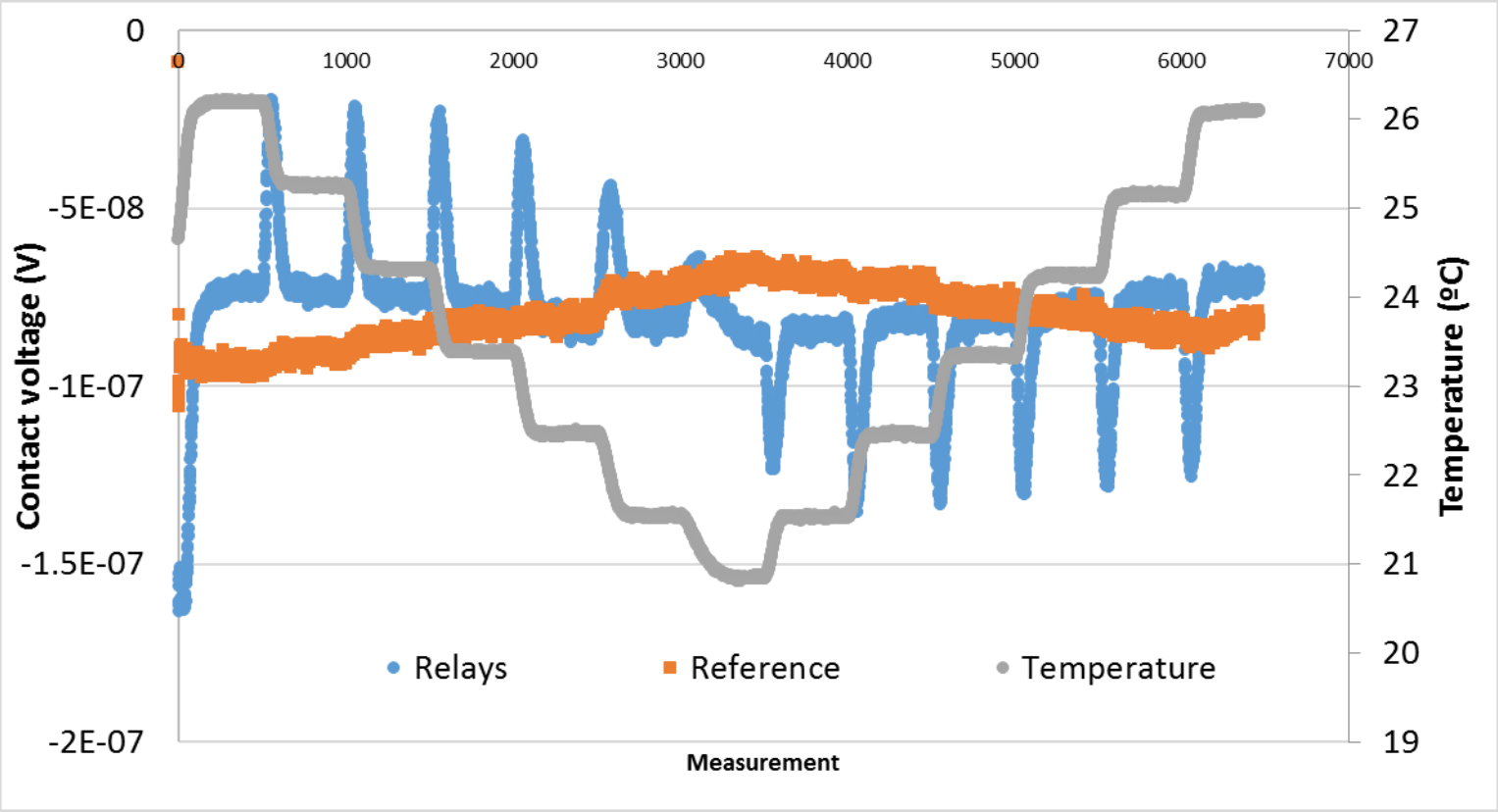
<1 ppm V dc

<25 ppm V ac

<5 ppm ohm

<adtoran@inti.gob.ar>

Electrical traceability chain



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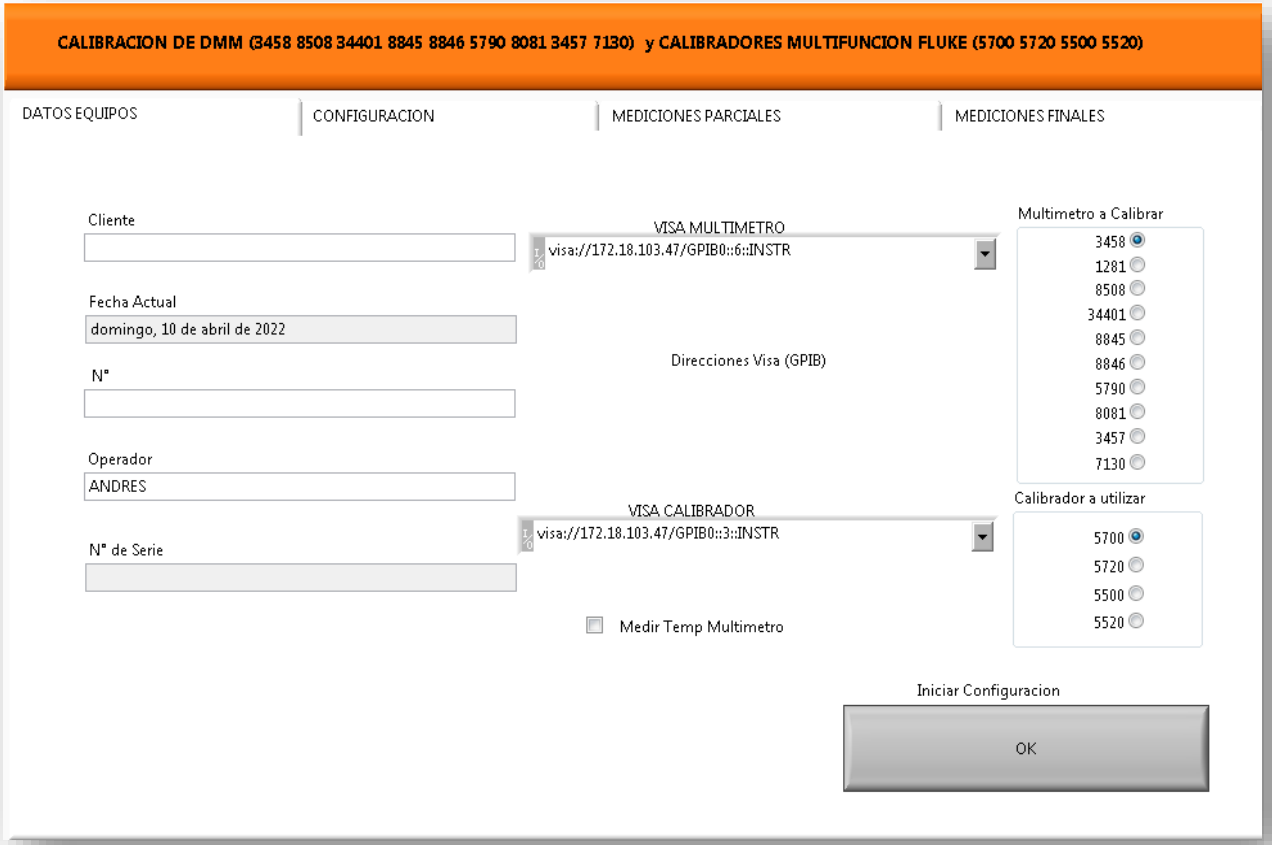
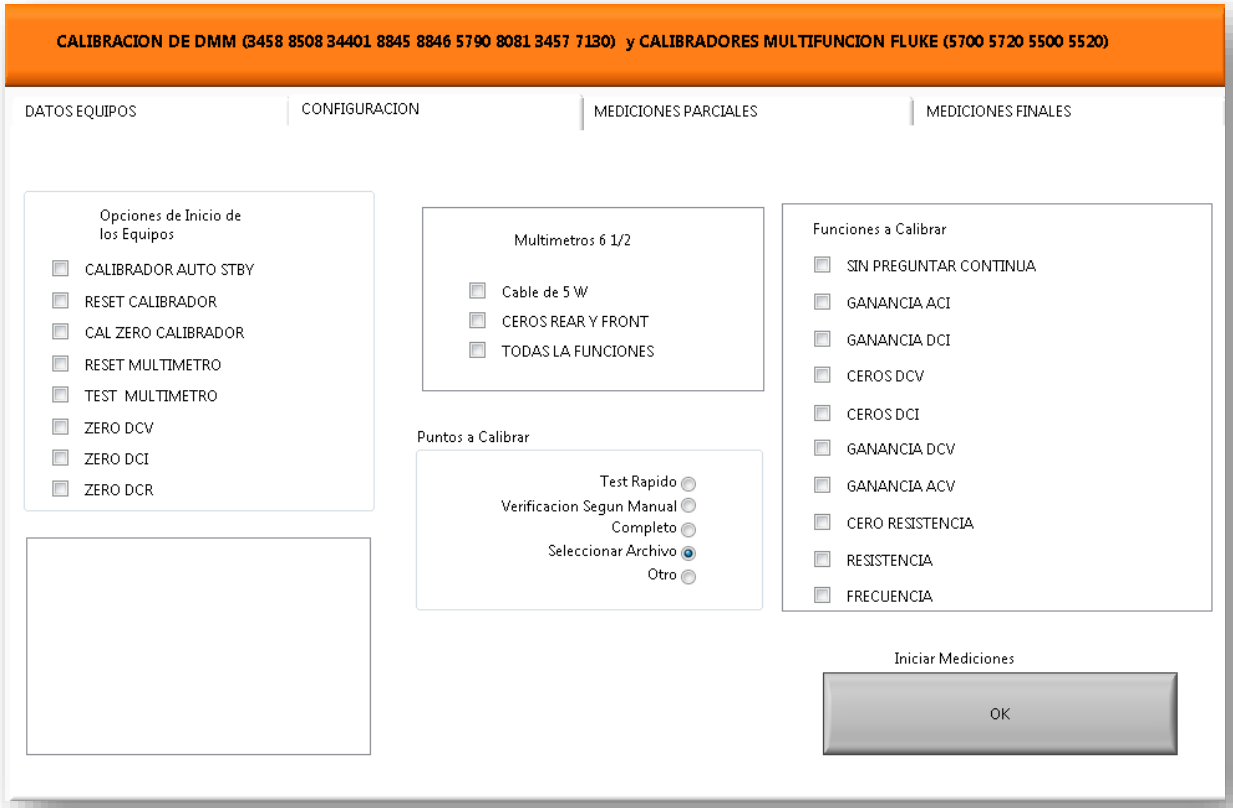
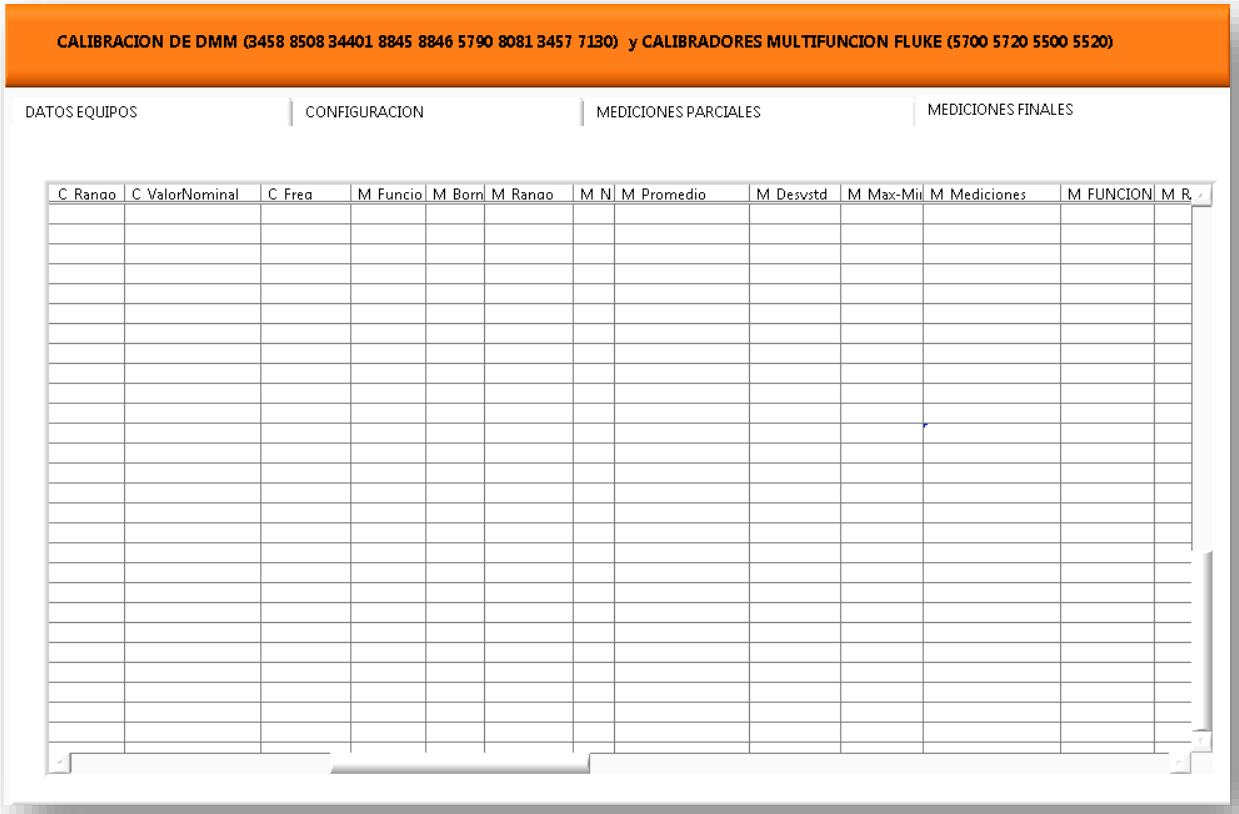


Electrical traceability chain



Electrical traceability chain



<adtoran@inti.gob.ar>

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Conclusions

Conclusion

The Digital Calibration certificate platform was implemented.

90 %

The partners are working to establish a digital traceability chain from primary standard up to vibration sensors.

50 %

A fully automated system to calibrate multifunction calibrator is under construction.

50 %

Thank you

mbierzychudek@inti.gob.ar

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